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Process and Apparatus for Drafting Textile Fibers

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BACKGROUND

The invention concerns a process for the drafting of textile fibers as well as an apparatus therefor, wherein the apparatus possesses a drafting chamber within which fibers are drafted.

Processes of this kind have long been carried out in drafting apparatuses having roll pairs placed sequentially one after the other. In this procedure, a roll pair is formed by a so-called cylinder and a pressure roll which are aligned with parallel axes and turn in opposite directions. The respective cylinder and pressure roll of the pair rolls following sequentially, one after the other, rotate with increasing speed. The fibers (in the form of one or more fiber bands) are consolidated between the cylinder and the pressure roll and are taken through each respective roll pair at the rotational speed of that roll pair, whereby a drafting of the fibers between each roll pair is achieved. These known and established processes are today from technical standpoints almost abandoned.

SUMMARY OF THE INVENTION

The purpose of the invention comprises the development of a process as well as of an apparatus of the type mentioned in the introductory passages so that, by the introduction of new technologies, prerequisites for parameter optimization in the tensioning process are created. Additional objects and advantages of the invention will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the invention.

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This purpose is achieved by the process of the introductory type in that at least one fluid is brought to the fibers to be drafted in such a fashion that it entrains the fibers and at least brings into play a part of the force necessary for drafting.

This purpose is achieved by an apparatus of the kind mentioned in the introductory passages in that a feed device for the inlet of at least one fluid to the fibers which have been brought into the drafting chamber is so constructed that the inlet fluid exerts at least a part of the necessary tensile force for the drafting of the fibers.

The advantages of the invention are especially comprised therein in that at least one fluid is conducted to the fibers to be drafted, in order either to completely execute the drafting process or to act as auxiliary thereto. For the production of a relative movement of the fibers between one another, one fiber must be restrained and a second relative to the first is accelerated. Restraining and accelerating are achieved in the conventional draftworks by the consolidation of the concerned fibers in roll pairs which are situated sequentially apart from one another in the direction of the drafting, and which turn at various rotational speeds. In the case of a draftworks functioning with at least one fluid, the fibers are likewise factually consolidated in that the fluid entrains the fibers and restrains some as other fibers are accelerated. In order to permit this to occur, a necessary inter-fiber cohesive friction must be overcome on the fibers to be drafted. In accord with the invention, at least one fluid medium must be brought in as support for the process of acceleration and restraint.

The fluid exerts a force to accelerate a fiber portion in the direction conducive to drafting. Alternatively or additionally, at least one or another fluid entrains the desired slower fibers and restrains or retains these in comparison to the fibers moving more

quickly. For the attainment of this consolidation or restraining action, the at least one fluid first can exhibit a flow component and thus a force component on the fiber in the drafting direction. This force, however, must be less than the pulling forces holding the more rapidly moving fibers. This is comparable to the situation in conventional draftworks in which the upstream roll pair shows a lesser RPM than does the downstream pair. Second, the at least one fluid can possess also a flow component and thus a force component counter to the drafting direction, and in this way restrain the fibers involved. For the acceleration of a part of the fibers and the restraining of another part, different fluids can be employed.

The at least one fluid can completely or supportingly accelerate those fibers where velocity is considered, which are in a state of more rapid motion, and/or in comparison to these, restrain the more slowly traveling fibers.

As an example for a supportive action, at least one fluid can be employed in addition to the use of mechanical draftwork rolls. This fluid will thus draft the fibers and assist in the draft. The fluid, in such a case, could undertake a very flexible role. For instance, by means of a change in pressure of the fluid, the force acting on the fibers can be quickly and precisely changed. Also, in the general drafting process, a penetration into the more inner lying fibers of a fiber band becomes more effective with a fluid than with a purely mechanical draftworks.

By the choice of a selected flow of the fluid, the cleansing effect comes into play, very short and therefore undesirable fibers can be removed from the fluid flow by flow carrying relatively low kinetic force, and additionally the longer fibers are removed by a

flow at a correspondingly higher kinetic force. The flow direction of the fluid can, in this case, likewise be adjusted to the requirements of a specific application.

In the case of the procedure in accord with the invention, all possible fluid media may be employed, these could include: a liquid, a gas, a gas mixture, or a combination of at least two of the said media. In accordance with the type of fiber to be drafted, the fiber length, and thickness, the most appropriate fluid for the application can be selected. This along with model-computing, requires a certain empirical know-how. The employment of water, air or a combination of water and air is especially low in cost.

In order to put to use the kinetic force of the flow efficiently, the apparatus in accord with the invention possesses an essentially tightly sealed drafting chamber. Fiber and fluid inlets as well as outlets for the same are advantageously provided and sealed.

In an advantageous embodiment of the invention, the drafting chamber possesses several progressively narrowing drafting chamber sections arranged stagewise or continuously in the drafting direction. Because of the geometric design of the drafting chamber, the fluid flows at an increasing velocity in the drafting direction, thereby carrying the fibers along with it. The fibers which are still found in the upstream sections of the drafting chamber are accordingly accelerated more slowly. In this manner, higher velocities of a portion of the fibers at the outlet of the drafting chamber can be assured.

In this embodiment of the invention, the fluid can entrain the fibers along its entire drafting chamber length. The fibers can be consolidated over the complete length of the draftworks chamber and restrained relative to one another or can be accelerated.

Those fibers, which during the process of drafting, should experience relatively

little acceleration can be retained behind the more rapid fibers by a relatively low kinetic force flow in the drafting direction, or also by a flow in a reverse direction. Additionally or alternatively, the necessary restraining force can, at least partially be exercised by mechanical, pneumatic, and/or electrostatic action on those fibers which during the drafting procedure remain behind the more accelerated fibers. For instance, to achieve the drafting a consolidation roll holds a portion of the fibers back so that another part of the fibers can be moved in a drafting direction by means of fluids flowing in the drafting direction, and/or if necessary moved by an additional mechanical drafting device, for instance a roll.

If first, a counter directed flow, or second a fluid flowing relatively slowly in the drafting direction restrains the consolidated fibers in the come-along effect entrained with more rapidly accelerated fibers, then this fluid is advantageously the same fluid as that fluid acting in the drafting direction, usually water or air. The counter flow can in the manner of the fluid which accelerates the fibers, be directed by means of conducting lines to its position of activity, i.e. injection. Alternative or additionally, correspondingly designed nozzles can be installed. These are advantageously so placed and constructed that they can efficiently entrain the fibers, and these fibers in relation to one another are thereby accelerated or restrained. In the way of example, several nozzles are placed about the fiber band(s) or about the relatively loose fibers. These nozzles are placed in a plane perpendicular to the drafting direction and essentially directed either to or against the drafting direction.

By means of the process in accord with the invention, single fibers mixed together,

fiber flocks, or fiber bands can be drafted. In the conventional draftworks, on the other hand, nearly exclusively fiber bands are drafted so that the process in accord with the invention can embrace a wider area of application.

Advantageously, the fluid can be applied by means of an injector under appropriately chosen pressure, preferably through direct injection into the drafting chamber. An injector comprises in this service a double walled tube with, as seen in cross-section, concentric tube walls. Through the outer tube the fluid with high pressure can be directed while the inner tube is supplied with fibers. At the outlet of the double tube, the fluid entrains the fibers in the form of thin strands so that in this way, for instance out of single fibers, a thin nap can be formed. By the use of an injector it is also possible to suck fibers out of a fiber supply container and transport the same into the drafting chamber. The shape of the injectors and their nozzles can be adapted to suit the corresponding application circumstances.

For an efficient recycling of the fluid after the one-time through-flow of the drafting chamber, the practical solution is to place the fluid in a circulation system in or outside of the drafting chamber. In some cases, a filter will be necessary to prevent fiber remains from building up in the circulating fluid. Such buildups lead to pressure variations, or in the worst cases to complete blockage of the fluid flow tubing.

For instance, in the employment of water as the acting fluid, the twisted fibers cling with greater strength to one another in the fluid than in the dry state. On this account, a provision is advantageously made to treat the fibers with an additive to reduce the tendency to cling to one another. For instance, an oil is a usable additive for this purpose,

which can be simultaneously employed to pretreat the fibers for subsequent working procedures. In this way, for instance, a cleansing oil can be introduced to the fibers in this step. In this way an economical operational step reduction can be achieved.

The process in accord with the invention can be installed in all spinning machines in which fibers are to be drafted, particularly in carding and drafting machines. If the process is installed in a drafting machine, then the draftworks is placed in the mentioned drafting chamber.

If the process in accord with the invention is used in a draftworks, it can be extended to the drafting operation as a preliminary or subsequent step in the drafting machine.

If the fibers run through a carding machine before the entrance into the drafting machine then the carding process, that is the freeing of single fibers from one another and creating a matting or a tenuous material, can advantageously be at least in part supported by means of the fluid. Also a cleaning of the fibers can be at least carried out in part by means of the fluid. The carding, and if needed also the cleaning, are advantageously undertaken by the apportioned injection of fluid with a corresponding pressure directed into the fiber volume to be carded. More advantageously, the same fluid is put to use for the carding procedure as is used for drafting in the drafting machine. In this operation, the fluid exiting from the carding machine can be used subsequently for the drafting procedure in the drafting machine, and thereafter again returned to the carding process. Very advantageous in such a recycling is to interpose filters for the removal of contamination in the fluid flow.

Likewise, the drafting machine can be installed following a spinning apparatus. In this case, fluid emerging from the drafting chamber, or from a front installed carding machine, can be used for the entwinement of the fibers in the spinning apparatus. Such an entwinement is also known as an "air spinning" operation.

If a fluid is used for the drafting of the fibers, then fibers after the drafting in certain cases are advantageously dried in order to deposit them in cans or to use them for further work-up. Otherwise, the result would be that the fibers deposited wet could suffer a loss in quality due to the high degree of dampness.

Advantageously, those fiber containers and the feed apparatus related to the drafting chamber for the feed of the fibers are peripherally sealed in order that a sequence of essentially tightly sealed apparatuses can be created, all of which can be subjected to the fluid. The fluid can then take over various functions. First, it can serve for the removal of the fibers out of the fiber supply container, since for instance a nozzle is directed laterally on the first layers of the fibers in the supply container and conducts these to the drafting chamber. In case the fiber supply container contains single loose fibers or fiber flocks, and material not yet in a fiber matting state, then in front of the drafting chamber advantageously an apparatus for producing a matting, fleece, or fiber band is provided. This is in order that this matting can be drafted in the drafting chamber. A new and inventive possibility arises in this regard in the application of an injector as described above.

In a particularly advantageous arrangement, the drafting process in accord with the invention and/or the described carding and spinning processes are controlled or regulated

where at least one fluid is employed in the associated control and/or regulatory operational apparatuses. In particular, such a control and/or regulator is employed for the addition of the fluid to the drafting chamber. By means of appropriate sensors, the functions of which are essentially analogous to the known sensors on conventional draftworks, fiber parameters such as fiber band thickness and its uniformity can be determined at the entrance and the exit of the drafting machine. From the sensor collected data, corresponding signals can be transmitted to the control/regulation apparatus(es). Such an arrangement controls and/or regulates advantageously also the feed apparatuses for the fluid in order that the matching pressure, i.e. tensile forces, are brought to bear. Advantageously, in accord with the flow cross-sections of the fluid, the pressure and/or duration of application can be controlled/regulated.

Advantageous developments of the invention become evident in the features of the subordinate claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention with the aid of the drawings will be more closely described. There is shown in:

- Fig. 1 a schematic presentation of a first embodiment of the drafting apparatus in accord with the invention,
- Fig. 2 a schematic presentation of a fiber band with two consolidated sections because of flowing fluid in a drafting apparatus,
- Fig. 3 a schematic presentation of a fiber band with two consolidated sections because of not only the situation of Fig. 2, but also because of a fluid flowing in a counter direction in said

apparatus, and

Fig. 4. a schematic presentation of a second embodiment of the drafting apparatus in accord with the invention.

In Fig. 1, a drafting chamber 1 is schematically depicted for the drafting of the fibers 6 of a fiber band. The drafting chamber 1 is shown with an inlet 9, followed by three subsequent sections 2, 3 and 4 which are telescopically arranged and progressively smaller. These sections extend themselves in the direction of drafting V toward an outlet 8 of the drafting chamber 1. The fibers 6 which are drafted in relation to one another are conducted through this telescopically arranged chamber to the mentioned outlet 8. A supply container 20 is sealingly attached to the drafting chamber 1 from which the fiber band to be drafted is drawn through a transition hood 10 to the entry 9 of the described drafting chamber 1. In order to guide the fiber band into the drafting direction V which runs parallel to the longitudinal axis of the drafting chamber 1, a change of direction roll 5 is provided at the entry 9 of the drafting chamber 1. In the transition hood 10 is found a top located, tube-like feed entry 11, through which a fluid 7 is guided into the drafting chamber 1. In this operation, a deflection vane 13 serves to divert at least a portion of the flow of fluid 7 toward the entry 9 of the drafting chamber 1. In its most simple construction, the deflection vane 13 is a plain sheet of sheet metal.

Since both the fiber supply container 20 as well as the transition hood 10 possess the same cross-section, they can be coupled together by means of peripheral sealants 15, 25, and if necessary an additional clamping means. This will prevent first, ambient air from entering in significant quantities into the system drafting chamber 1, transition hood

10, and fiber supply container 20, and second, prevent the loss of fluid 7 from within the system.

The fiber band, that is the fibers 6, can be transported by various means from the fiber supply container 20 to the drafting chamber 1. An embodiment (not shown) prefers a mechanical transport, for instance by a comb pick-up roll or like transport. As an alternative, a flowing fluid 7 can be put to use. More advantageously, the fluid 7 in this service is the same fluid 7 which is being employed for the drafting operation. Especially in the case of supply containers 20, filled with single fibers and fiber flocks, a laterally placed nozzle directed on an upward slant can be penetratingly installed.

The nozzles would be installed slightly under the fiber surface and be movable in the vertical direction.

The fibers 6 in the flowing fluid 7 would be entrained in an upward flow from said nozzles, and transported to the drafting chamber 1. Also a suction removal apparatus for taking the fibers 6 out of the supply container 20 can be installed. In order to avoid a possible low pressure in the fiber supply container 20 by the flow in the drafting chamber 1, a valve 21 is provided which can be activated either manually or electrically.

Because of the telescopic formation of the drafting chamber 1, the fluid 7 from section to section, i.e. 2 to 3 to 4, in the drafting direction V is progressively more strongly accelerated and in section 4 (or 3) can correspondingly in the smaller cross-section effect a stronger come-along and consolidation force on the fibers 6 found there and provide a greater acceleration for said fibers than was the case in the section 3 and 2 (or 2) where larger cross-sections were in order. Schematically, this situation is

presented in Fig. 2. For the sake of simplicity, in Fig. 2 only two consolidation sections 30 and 31 are shown which represent the two sections of the 2, 3, 4 arrangement of Fig. 1. In Fig. 2 the arrows assigned to the fibers 6 represent, in their direction and length, the tensile, entraining forces acting in the respective consolidation positions 30 and 31 on the fibers 6. It is also possible to inject different fluids 7 into the consolidation positions 30 and 31.

As is depicted in Fig. 3, it is possible for a portion of the fibers 6 in alternate behavior at a consolidation position, i.e. a section 40, to be restrained or consolidated by a fluid 7 in counter flow. In this situation, the same fluid 7 can be employed, which for the purposes of the drafting, exhibits acceleration components in the drafting direction V and consolidates and accelerates fibers 6 at the consolidation section 41. In this variant arrangement (not shown) further transport means are required in order to transport the fibers 6 in the drafting direction V. Such transport means are in some cases also advantageous or necessary in the other described embodiments.

By the use of only one fluid 7 for the variants of the Figs. 2 and 3, in most cases a single inlet 12 in the drafting chamber 1 suffices for the fluid 7 in order to achieve a separation of the fluid 7 in the drafting chamber 1, besides that embodiment shown in Fig. 1.

This is done by means of a proper choice of change of direction devices or several correspondingly directed nozzles. In this flow/counter flow, a first fluid sub-current takes over a greater acceleration of a portion of the fibers 6, while a second fluid sub flow tends to a slower flow (relative to the first) for another portion of the fibers 6. Care must be

taken in respect to the respective second sub flow protective apparatuses that turbulence in the drafting chamber disturbs neither the restraining nor the acceleration action. In accord with the invention, a fluid 7 can be employed essentially either only for the restraining or only for the acceleration of the fibers 6, seen as respectively relative to one another.

As is also shown in Fig. 1, it is likewise possible to provide more than two consolidation sections 30 and 31, or 40 and 41. By this means a more precise drafting can be achieved.

In an additional alternative (not shown), the fibers 6 are mechanically restrained or accelerated, for instance by one or more consolidation rolls. The restraining or the acceleration can also be carried out electronically and an apparatus can be constructed with oppositely poled components in the immediate neighborhood of the fibers to be consolidated or restrained.

In Fig. 4, a second embodiment of the invention provides that alternative to the step-wise, successive sections of diminishing cross-sections 2, 3, and 4 of Fig. 1, nozzles 52 and 53 are directed against the sections 50 and 51 of the drafting chamber through which the fibers 6 are flowing. For the generation of the accelerating effect nozzles 53 are placed in the downstream located sections 51 of the drafting chamber 1 and are essentially pointed in the drafting direction V. If contrary to this the fibers 6 should be previously restrained, then nozzles 52 are advantageously located in the upstream sections 50 of the drafting chamber and, in the embodiment of Fig. 2 are directed contrary to the direction of drafting V against the fibers to be restrained. Advantageously,

in both cases respectively a plurality of nozzles 52 and 53 are provided which are placed about the entire zone of the fibers 6 in the drafting direction (not shown) and thus from almost all sides act upon the fibers.

This is done so that on the average of the fiber bundle, a uniform drafting can take place. Additionally or alternatively, a plurality of nozzles 52 and 53 are located along the drafting path which are all directed in the drafting direction V. Fluid with increasing pressure in the downstream direction is brought into the drafting chamber 1 in order to attain a successive greater acceleration of the fibers 6 (similar to the action in the apparatus shown in Fig. 1). In general, many variants of the nozzle arrangement and the pressure applied at these nozzles 50 are possible. Especially, these variants depend upon the purposes of the individual application, and likewise upon whether or not the fluid 7 is to apply a restraining or an accelerating force.

The first computations have produced the information that the fluid 7 for fiber acceleration must flow at a pressure of some 12 - 15 atm. in order to exert the same pressure as a pulling roll on a consolidation width of a half a centimeter.

The process in accord with the invention and the apparatus in accord with the invention can be applied in the most varied areas of the spinning technology in order to achieve a drafting of fibers. More explicitly, they can be applied in carding and drafting machines. It should be appreciated by those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit and scope of the invention.